Commentary: Screw your (virtual) courage to the sticking-place and cut!

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Macbeth: If we should fail?

Lady Macbeth: We fail? But screw your courage to the sticking-place, and we'll not fail.

—William Shakespeare, *Macbeth*

William (Bill) Paton Cleland was a pioneer cardiac surgeon in England whose expansive contributions in the 1950s to 1970s shaped the field of open surgery in Britain. His consultancies in London took him to the Royal Postgraduate Medical School and the Hammersmith Hospital, where he connected with Dennis Melrose, who was then developing the first European cardiopulmonary bypass machine. In April 1953, together with his young apprentice, Hugh Henry Bentall, Bill Cleland performed the first successful open operation in Britain on a middle-aged woman with severe aortic stenosis.¹ After this triumph, Bill Cleland went on to develop a wide range of congenital and acquired heart operations, culminating in the treatise titled “A Decade of Open Heart Surgery” in *The Lancet*, detailing more than 1200 operations and showing the safety of extracorporeal circulation.² On November 26, 1959, Bill Cleland operated on a 42-year-old man who had a 6-year history of chest pain, syncope, and a diagnosis of “some type of muscular obstruction to the left ventricular outflow tract.” On the table, Cleland was reluctant to proceed. Gathering his inner Lady Macbeth, the cardiology registrar on the case, Arthur Hollman, urged Cleland to operate. Through the aortic valve, which was normal, Cleland resected only a portion of the obstructive muscle. Despite “only minimal resection” and an unchanged pressure gradient, the patient's symptoms improved and he was free of angina. Thus, the first surgical myectomy was deemed a success.³

The need for some courage in performing surgical myectomy for hypertrophic cardiomyopathy, especially in the first few instances, is well known. We all appreciate how to get to the obstructive septal muscle and where to cut. But the “trick of the trade” is to resect

William Paton Cleland, FRCP, FRCS (1912-2005)

Central Message

Preoperative planning with 3D CT and virtual septal myectomy does not lead to more extensive resection in patients with hypertrophic cardiomyopathy.

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enough of the hypertrophied septum to eliminate left ventricular outflow obstruction without making a ventricular septal defect, biopsying the Purkinje fibers, or damaging the aortic valve. Thus, successful and reproducible results have been reported by only a few experienced centers. In this issue of the *Journal*, Takayama and colleagues⁴ described their preoperative adaptation of gated 3-dimensional (3D) computed tomography (CT) and virtual surgery software to guide the volume and extent of myectomy before surgery. Although the preoperative CT and virtual training may have helped Takayama and colleagues⁴ plan the myectomies, the data suggest that, despite good hemodynamic results, the actual amount of resected septal muscle remained *less* than the ideal amount predicted by the virtual surgery. The conclusions that can be drawn from the study are as follows: (1) The authors' team achieved good surgical outcomes; (2) these outcomes were accomplished with what appeared to be a more conservative resection; (3) the preoperative 3D CT and virtual surgery did *not* lead to a more aggressive or ideal resection; (4) an ideal or aggressive resection was not necessary to achieve acceptable clinical results; and (5) it remains unknown whether the more conservative resection will lead to late recurrence of outflow obstruction. In the end, practicing in a 3D virtual environment preoperatively did not produce ideal resections. So, the question that needs to

be asked is, did the 3D CT and virtual myectomy contribute in a meaningful way?

Unfortunately, this question cannot be answered by this study. This is a retrospective case series without a comparative design or outcome assessment before *and* after the introduction of the virtual surgery, let alone a randomized trial. Therefore, we do not know if Takayama and colleagues⁴ would have achieved the same hemodynamic and clinical results, or equivalent amount of muscle resection, without the 3D CT or virtual training. This is the missed opportunity in this study, and the fundamental question remains: Does 3D CT plus virtual surgery guide more resection safely and render better hemodynamic outcomes? Nonetheless, the authors' use of gated 3D CT in diastole to delineate the "volume" of obstructive asymmetric septal muscle is logical and well explained. Clearly, both transthoracic echocardiography and magnetic resonance imaging lack the fidelity and precision that CT provides. I will certainly be asking for 3D CT before my next surgical

myectomy for hypertrophic cardiomyopathy and hope to gain some "virtual" courage in the process.

Interestingly, Bill Cleland originally planned to become a chest physician but was told that he had such good hands that he should become a surgeon. His mother would later comment on her son's distinguished cardiac surgical career at the Hammersmith with surprise: "Bill was never any good at carpentry." To this, Cleland retorted that cardiac surgery was more akin to plumbing, just with a bit more courage.

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